Cobolt

Owners Manual

Model 05-01

March 2014 rev 1.20

Cobolt Zouk™

CW 355 nm DPSSL

Cobolt Calypso™

CW 491nm DPSSL

Cobolt Samba™

CW 532nm DPSSL

Cobolt Jive™

CW 561nm DPSSL

Cobolt Flamenco™

CW 660nm DPSSL

Cobolt Rumba™

CW 1064 nm DPSSL

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1. General

Cobolt lasers are all continuous-wave diode-pumped solid-state (DPSS) laser devices operating at fixed wavelengths as defined in the specifications in Section 6. The lasers have a compact hermetically sealed package and emit a high quality beam with stable characteristics over a wide range of operating conditions. The lasers are designed and manufactured to ensure a high level of reliability.

The Cobolt lasers are intended for stand-alone use in laboratory environment or for integration into instrumentation equipment used e.g. in flow cytometry, fluorescence microscopy, particle & flow analysis, DNA sequencing, interferometry, Raman spectroscopy, optical tweezers and laser pumping.

2. Safety and precaution instructions

Eye and skin exposure to direct or reflected laser light is hazardous and may be extremely harmful. Always wear eye protection appropriate to the beam wavelength and intensity. The device must be handled by personnel with experience in laser operation, in a laboratory environment and with access to adequate laser safety equipment.

Product	Output Power (mW)	CDRH Class	IEC Class
Cobolt Zouk™ 355 nm	10 and 20	IIIB	3B
Cobolt Calypso ™ 491 nm	200	IIIB	3B
Cobolt Samba™ 532 nm	500, 1000, 1500	IV	4
Cobolt Jive™ 561 nm	200 and 300	IIIB	3B
Cobolt Jive™ 561 nm	500	IV	4
Cobolt Flamenco™ 660 nm	100 and 300	IIIB	3B
Cobolt Flamenco™ 660 nm	500	IV	4
Cobolt Rumba™ 1064 nm	500, 1000, 2000, 3000	IV	4

The table below described the maximum irradiance in W/cm^2 and appropriate level of eye protection in terms of optical density (OD) for each product line.

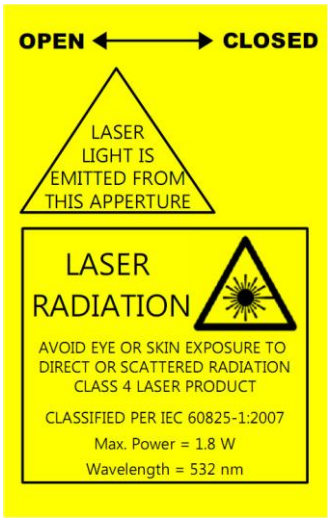
Product	Output Power (mW)	Max Irradiance (W/cm^2)	Eye protection Requirement
Cobolt Zouk™ 355 nm	20	6.5	> OD 4
Cobolt Calypso ™ 491 nm	200	65	> OD 3
Cobolt Samba™ 532 nm	1500	470	> OD 4
Cobolt Jive™ 561 nm	500	160	> OD 4
Cobolt Flamenco™ 660 nm	500	160	> OD 4
Cobolt Rumba™ 1064 nm	3000	460	> OD 4

Always install the laser system to a properly grounded power outlet; Cobolt lasers contain a laser diode which is sensitive to electrostatic discharge (ESD).

CAUTION – use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

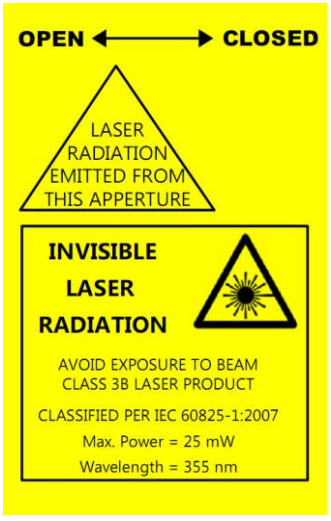
2.1. Warning labels

The Laser Head clearly displays a warning label that shows the location of the laser beam from the aperture and an explanatory label stating the laser safety class compliance of the product. These labels must be visible unless the laser beam is totally enclosed.

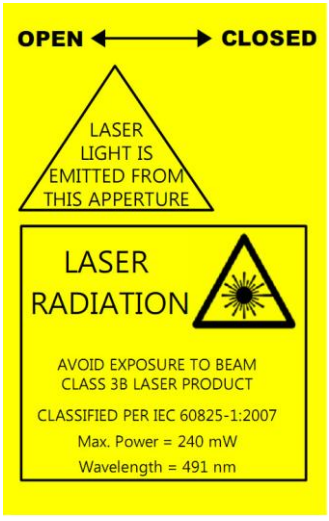


Visible Class 4 lasers

IR Class 4 lasers



UV Class 3b lasers



Visible Class 3b lasers

Examples Hazard Symbol and Aperture Label

3. Laser design

The radiation from Cobolt lasers is generated by intra-cavity frequency conversion in periodically poled material. The laser beam is expanded in a telescope and emitted through a manual shutter. The residual IR radiation from the pump and the DPSS laser is contained within the laser housing by filtering optics.

The laser assembly is equipped with elements for temperature control of the cavity and pump diode. The laser is also featured with an optical feed-back loop which ensures long-term power stability of the emitted visual beam. Control signals and drive currents are supplied via an electrical interface.

4. Laser system description

The Cobolt 05-01 laser system consists of four main parts: Laser Head, Controller, Cable and Power supply. The Cobolt Cable should always be used to connect the Laser Head with the Controller.

Cobolt Laser Head, Controller and Cable

4.1. Laser Head

The Laser Head contains pump diode, laser cavity, beam formatting optics and Peltier elements. The Laser Head gets electrical power and control signals from the Controller via a 26-pin cable. The laser system is CDRH compliant together with the CDRH model of the Controller and the Power supply unit. The Laser Head has a manual shutter as well as a laser hazard label and a laser classification label.

4.2. Controller

The Controller supplies driving current and control signals to the Laser Head. The operation setpoints are specific to each Laser Head and have been fixed during manufacturing.

The status of the laser operation is given via LED indicators:

POW	(green light)	Power is supplied.
		Blinking LED indicates that the internal temperatures are stabilizing.
ON	(orange light)	Laser light is on in constant current mode.
LOCK	(orange light)	Laser light is on and the output power has been locked to setpoint.
		The laser is operating according to specifications
ERR	(red light)	An error has occurred. No laser light.

The Controller can be configured in two ways (decided at laser purchase):

- **CDRH Controller**: A key is supplied to be used to turn on the laser. The laser will be running according to specifications in <3 min. See Section 5.1 for more information. The status of operation is monitored via LED signals. Setting the turn key to its OFF-position puts the laser in stand-by mode.
- **OEM Controller**: The Controller is factory set so that no key is needed to turn the laser on. Connecting 15 VDC power supply to the Controller initiates an automatic start-up sequence. See Section 5.1 for more information. The laser will be running according to specifications in <3 min.

The operation of the laser can be controlled and monitored via the Data port (supports control commands and analog signals). See Section 9 for further details.

When power is supplied to the Controller, regardless of on/off state, the temperature control elements are operating to reach setpoint values. The Controller includes a remote interlock connector, 2-pins on the left hand side within the 6-pin analog connector. The connector can be short-circuited with an interlock jumper (included at delivery) for operation of the laser. To make use of the remote interlock as a safety switch, remove the jumper and connect to an external switch. NOTE: when the interlock circuit has been opened during operation, the laser needs to be disconnected from and then reconnected to the power supply in order to start again. Alternatively, it can be re-started using a special sequence of control commands, see Section 9 for further details.

4.3. Cable

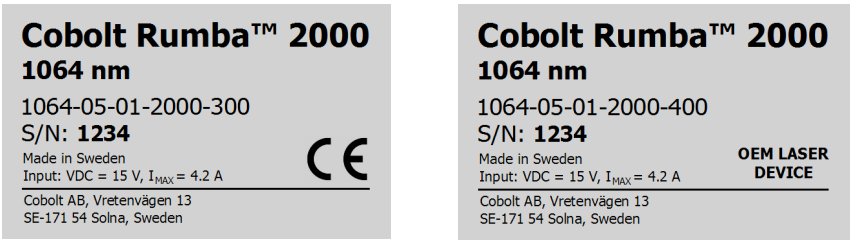
The Cable connects the Laser Head to the Controller. The standard Cable length is 1 m and minimum bending radius 8 cm. When connected care should be taken not to bend or break any of the 26 pins.

4.4. Power supply requirements

An appropriate Power Supply Unit (PSU) is supplied by Cobolt with the laser for low volume orders and is plugged into a standard power outlet. The output from the Cobolt supplied PSU is 15 VDC, and the current is 4.2 A (max 63 W). The power supply accepts 90 – 264 VAC and 47–63 Hz. Ripple and noise 1% peak-peak max, 20 MHz bandwidth. Accepted voltage range for the Controller is 11 V – 28 VDC. Specification values are given at 15 VDC.

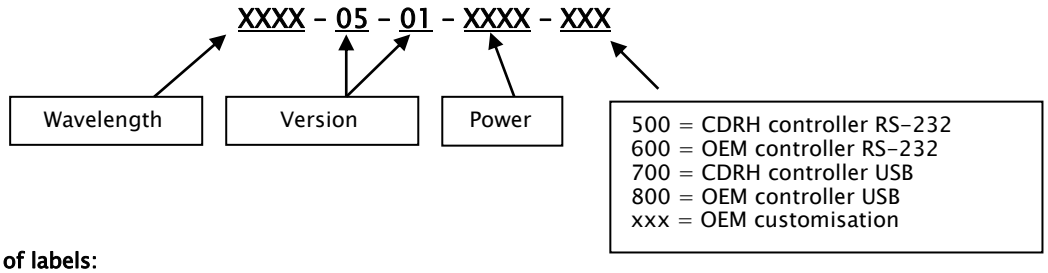
4.5. Identification labels

The Laser Head and Controller are provided with a manufacturer's identification label including a serial number which is unique for each laser system and a certification label.



Manufacturer's identification labels: CDRH (L) or OEM (R)

Model number description:



Placement of labels:

Hazard Symbol and Aperture Label

Manufacturers Certification label

5. Operation instructions

As standard, all lasers are delivered with the Controller set in Auto-start mode. As soon as power is supplied to the Controller the temperature control elements are operating to reach set-point values and the laser emission will start, unless the keyswitch is enabled (CDRH model).

5.1. Installation startup operation

1. Mount the Laser Head on a suitable heat sink (see Section 10).
2. Ensure that the interlock jumper is connected.
3. Connect the Laser Head to the Controller with the Cable and fasten screws at both ends.
4. Apply 15 VDC to power supply connector on Controller.
5. The laser now goes through the following autostart sequence:
   - Temperature stabilisation (1-2 min). Status LEDs: POW flashing, then POW goes on.
   - (For CDRH model: Turn key switch to start the laser. Status LEDs: ON goes on.)
   - The laser starts (light is emitted) in constant current mode (pre-set time of 60 sec). Status LEDs: ON goes on.
   - The laser locks to pre-set output power (<2 min) and operates according to specifications. Status LEDs: LOCK goes on.
6. Switching the laser ON/OFF (to/from stand-by mode) via control commands or Direct Control is described under Section 9.4.

5.2. Closedown operation

1. Disconnect PSU from mains outlet (turn the key switch to OFF first for CDRH model).
2. Disconnect Controller from PSU.
3. Disconnect Laser Head from Controller (only required for shipping).

6. Specifications

6.1. Optical

	Centre wavelength[1]	Output power[2]	Beam divergence (full angle, 1/e²)	Beam diameter at aperture
Zouk™	354.8 ± 0.3 nm	10 or 20 mW	<0.8 mrad	700 ± 50 µm
Calypso™	491.5 ± 0.3 nm	200 mW	<1.2 mrad	700 ± 50 µm
Samba™	532.1 ± 0.3 nm	0.5, 1.0 or 1.5 W	<1.2 mrad	700 ± 50 µm
Jive™	561.2 ± 0.3 nm	200, 300 or 500 mW	<1.2 mrad	700 ± 50 µm
Flamenco™	659.6 ± 0.3 nm	100, 300 or 500 mW	<1.5 mrad	700 ± 50 µm
Rumba™	1064.2 ± 0.6 nm	0.5, 1.0, 2.0 or 3.0 W	<1.6 mrad	1000 ± 50 µm

	Zouk™	Calypso™	Samba™	Jive™	Flamenco™	Rumba™
Noise 20 Hz – 20 MHz (peak-peak)	<2%	<5%	<1%			
Noise 20 Hz – 20 MHz (rms)	<0.2%	<0.5%	<0.1%			
Long-term power stability (8 hours)	<2% (±3 °C)					
Spatial mode	TEM_{00}, M^2 <1.1					
Spectral linewidth	<1 MHz (<0.001 pm)					
Coherence length	>100 m					
Beam symmetry at aperture	>0.90 : 1		>0.95 : 1			
Beam waist location (from exit window)	± 20 cm					
Beam angle accuracy	<5 mrad					
Beam position accuracy	<0.25 mm					
Beam pointing stability (over 10-40°C)	<10 µrad/°C, (typical <5 µrad/°C)					
Polarization ratio (linear, vertical)	>100:1					
Residual IR emission	<1 mW					

1. The wavelength is fixed with this accuracy, while drift is <0.02nm. The wavelength is specified in air.

2. The output power can be adjusted using control commands, see Section 9. Specifications are guaranteed at 100% of nominal power. Recommended power range is 50-100%. Nominal power accuracy 5%.

6.2. Operational and environmental requirements

Power supply	15 VDC, 4. 2 A. (11-28 VDC accepted)
Power consumption, total system (Laser Head + Controller)	<63 W (typical ~30 W)
Maximum heat dissipation of Laser Head	<50 W (typical ~20 W)
Maximum Laser Head baseplate temperature	50°C
Warm-up time, from OFF	<3 min
Ambient temperature, operation	10-40°C
Ambient temperature, storage	0-60°C
Humidity	0-60% RH non-condensing
Ambient Air pressure	950-1050 mbar
Heat sink thermal resistance, Laser Head	<0.2 K/W

6.3. Electrical interfaces

Interfaces	Connector	Function
Input power	Kycon KPJX-45, 4-pin	Power supply to Controller
Laser Head to Controller	HD-sub 26-pin, male	Connection to Laser Head
Controller to Laser Head	HD-sub 26-pin, female	Connection to Controller
Data port	USB-type mini B	Control and monitoring via control commands
Remote interlock & Analog signals	Molex 90130-3206	Analog input 5 – 12 V => laser on Analog input <2.7 V => laser off

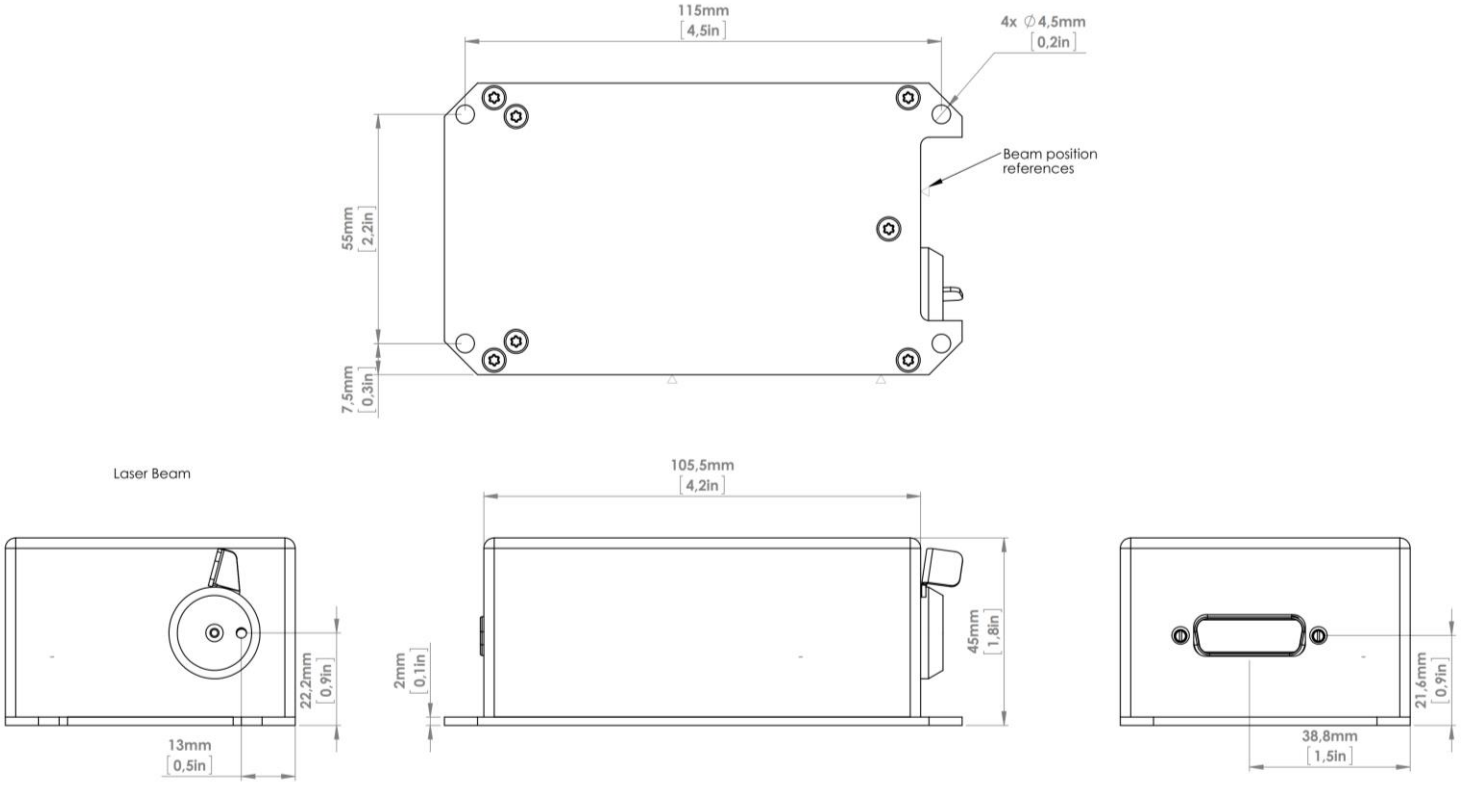
6.4. Mechanical

Dimensions:	
Laser Head	125x70x45 mm (5x2.8x1.8 inches)
Controller	190x72x28 mm (7.6x2.9x1.1 inches)
PSU dimensions	115x50x35 mm (4.6x2x1.4 inches)
Fixation holes, Laser Head	size M6 (fitting M4), spacing 115x55 mm
Fixation holes, Controller	spacing 51x178 mm
Cable (Laser Head – Controller)	1 m length, >8 cm bending radius
Laser head weight	0.6 kg

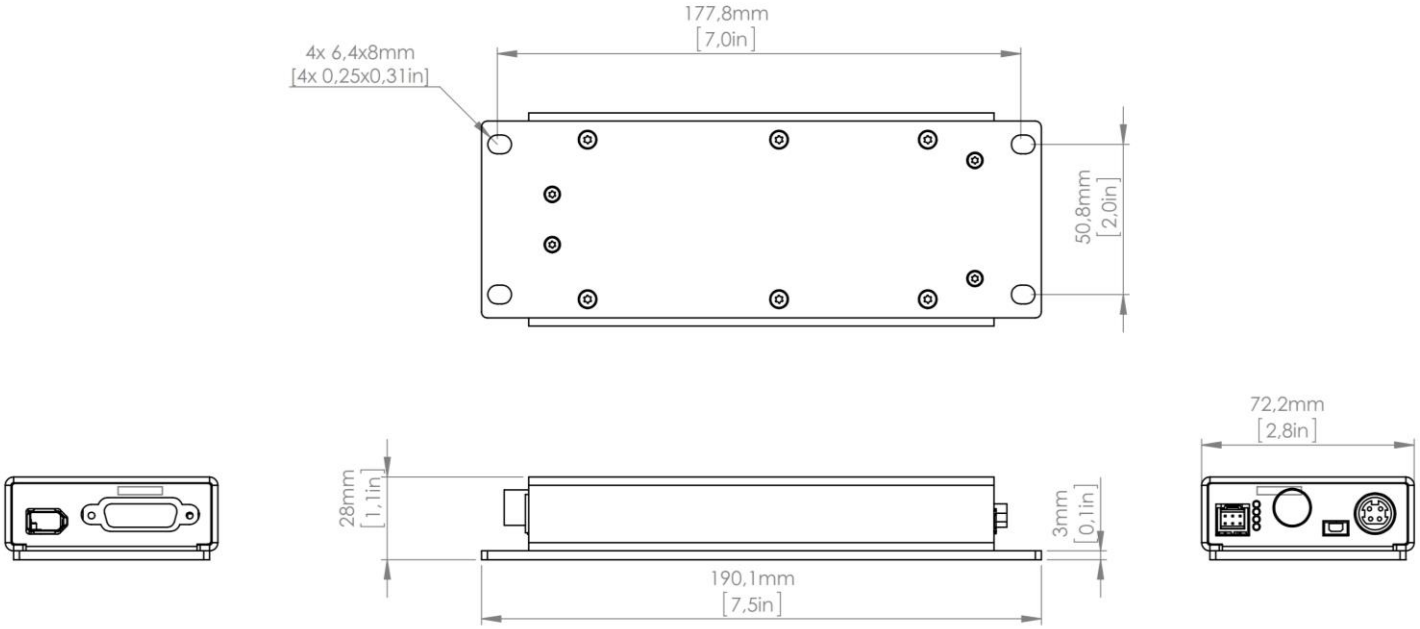
The information presented here is believed to be accurate and is subject to change without notice.

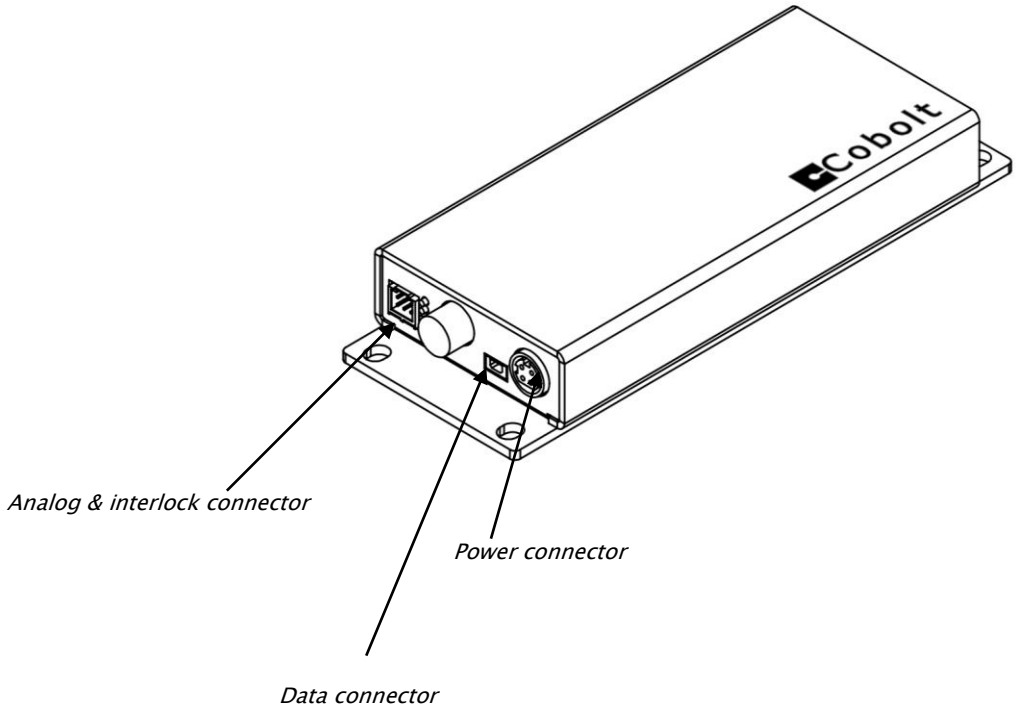
The specifications contained herein cannot be guaranteed outside of normal operational conditions.

7. Mechanical outlines



Laser Head mechanical outline model 05-01 (dimensions in mm and inches).

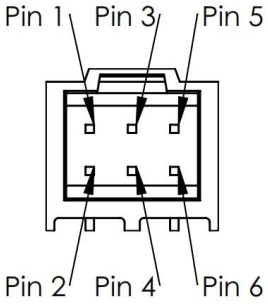




OEM & CDRH Controller mechanical outline (dimensions in inches and mm).

8. Connector drawings & pin assignment

8.1. Analog connector & interlock connector

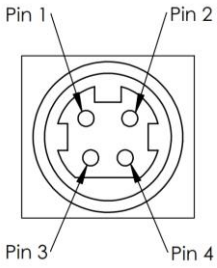


Manufacturer Molex 90130-3206, mates with 90143-0006.

Pin	Function
1.	Interlock (connect to pin 2 for enable)
2.	GND
3.	Analog on/off (Direct input)
4.	TST (Internal Cobolt use only)
5.	LED “Laser on” (5V)
6.	LED “Error” (5V)

Warning: shortening pin 2 and 4, when the controller is powered up, will erase the controller memory.

8.2. Power connector



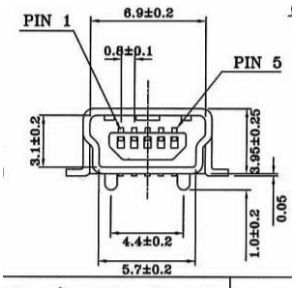
Kycon KPJX-4S, mates with Kycon KPPX-4P. Grounded shield.

Pin	Function
1.	0 V
2.	+11-28 VDC
3.	0 V
4.	+11-28 VDC

8.3. Data connector

Connector USB-type, manufacturer Hsuan Mao C8320-05BFDSB0, mates with connector mini-B.

Pin	Function
1.	+5 V (in series with internal 10 Ohm resistor)
2.	RS-232_TX
3.	RS-232_RX
4.	Not connected
5.	0 V (GND)



9. Operation via data port

9.1. Baud rates and serial port settings

To communicate with the laser, a communication cable needs to be ordered separately. Each Controller is shipped from the factory with a fixed baud rate (115200), which cannot be changed in the field. The other serial port parameters are: 8 data bits, 1 stop bit and no parity. Hardware flow control is not supported. Each command to the Controller must be terminated by a carriage return. All commands are case-sensitive. Leading and trailing white space is ignored, but command arguments must be delimited by a single space character (ASCII 32).

9.2. Handshaking

Under no circumstances does the Controller initiate communication; it only transmits characters in response to a message. Every message to the Controller generates a response, either a numerical value or the acknowledgment string “OK”.

In the event that the Controller receives a message that it cannot interpret, it responds: “Syntax error: ” followed by the complete command string (minus the termination character) that caused the error.

Every Controller response is terminated by a carriage return (ASCII 13) and a full stop is used with floating numbers.

9.3. Control commands

The laser is delivered with the Controller set in autostart mode (see Section 5.1 for autostart sequence description). For system integration the autostart sequence can be disabled (some commands require autostart disabled). The controller is factory set for RS-232 communication (-500/-600 model number) or USB communication (-700/800 model number). As long as power is supplied to the Controller the temperature control elements are always operating to reach set-point values and the laser will be idle waiting for the next command. All arguments are in lower case and separated by a space (ASCII 32).

Command	Function	Argument	Returned value
hrs?	Get laser head operating hours		Float
ilk?	Get interlock state		0 = OK, 1 = interlock open
@cobas	Enable/disable autostart With autostart disabled the laser will not go through the standard warm-up sequence, see Section 5.1.	0 = disable, 1 = enable	
@cobas?	Get autostart enable state		0 = disabled, 1 = enabled
l?	Get laser ON/OFF state		0 = OFF, 1 = ON
l1	Laser ON Requires autostart disabled. Use this command for manual ON (OEM models).		
l0	Laser OFF Use this command for manual OFF (OEM		

	models).		
p?	Get set output power		Float (W)
p	Set output power	Float (W) (e.g. p 0.050 for 50 mW)	
pa?	Read output power		Float (W)
i?	Get drive current		Float (A)
slc	Set drive current	Float (A)	
leds?	Status of 4 LEDs		Int [0:15] Bit 0 = "POWER ON" Bit 1 = "LASER ON" Bit 2 = "LASER LOCK" Bit 3 = "ERROR" 1 = LED on 0 = LED off
f?	Get operating fault		0 = no fault 1 = temperature error 3 = open interlock 4 = constant power fault
cf	Clear fault		
@cobasdr	Enable/disable direct control See sect 9.4 for description	0 = disable, 1 = enable	
@cobasdr?	Get direct control enable state		0 = disabled 1 = enabled
sn?	Get serial number		32-bit unsigned integer
@cob1	Laser ON after interlock Forces the laser into autostart without checking if autostart is enabled (OEM models).		
@cobasky?	Get key switch state		0 = disabled, 1 = enabled
@cobasky	Enable/disable key switch With the key switch disabled the laser is not CDRH compliant and laser safety no longer applies.	0 = disable, 1 = enable	

For re-starting the laser with control commands after having opened the remote interlock switch, execute "cf" for clear fault followed by "@cob1" to restart the laser. On CDRH models the key switch is the only way to re-start.

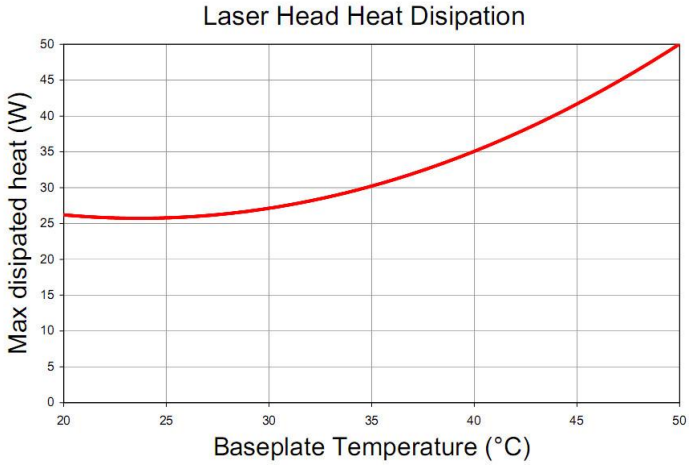
The output power can be adjusted from 10-110% of nominal power using the "p" command. Specifications are guaranteed at 100% of nominal power. Recommended power range is 50-100%.

9.4. Direct control

The Direct Control feature enables turning the laser ON/OFF using a 5-12 VDC signal. After having configured the Controller for Direct Control operation (factory set or by executing @cobasdr 1), the laser can only start-up when 5-12V VDC (max 12.5 VDC) is applied to pin 3 on the analog connector with 0 VDC on pin 2 as reference. Shifting the signal to 0 VDC on pin 3 will turn the laser off and put the laser in stand-by mode (status LED:s is POW and not flashing). This input only controls the on/off state of the laser and cannot be used to modulate the power output.

10. Thermal management

To ensure operation within given specifications and for the warranty to be valid, the Laser Head must be attached to a heat sink providing a thermal resistance of <0.2 K/W. The Cobolt heatsink meet this requirement. This value is the difference between the maximum allowed Laser Head base plate temperature (50°C) and the maximum specified ambient temperature at the air-heatsink interface (40°C), divided by the maximum power dissipated from the laser (~50 W for the highest power models at high ambient temperatures). The mounting surface should be flat (within ±0.05 mm over mounting surface). It is recommended to use a thermal heat compound between the Laser Head and the heat sink to provide good thermal contact. For assistance in thermal management and system integration, please contact Cobolt's technical support.



Typical curve of heat dissipation with respect to base plate temperature under extreme operating conditions with good thermal contact between the laser head and the temperature controlled base plate

11. Cobolt Monitor software

The Cobolt Monitor software provides a graphical way to monitor the laser performance and to change power, operation mode and other settings. The software can connect to the laser either via RS-232 port or via USB, depending on the type of controller. The USB driver must be installed manually and can be downloaded from the Cobolt website (www.cobolt.se).

11.1. Installation

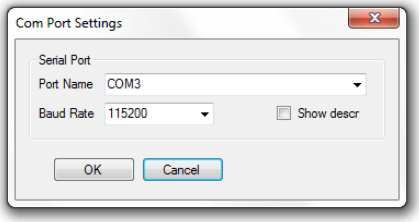
Microsoft .NET is required to run the Cobolt Monitor software, and this will be installed automatically if you do not already have the correct version. Follow the following steps to install the software:

1. Extract the archive and run the **setup** file.
2. **Accept** the Microsoft .NET framework EULA.
3. Setup will now connect to the internet and download Microsoft .NET if it is required.

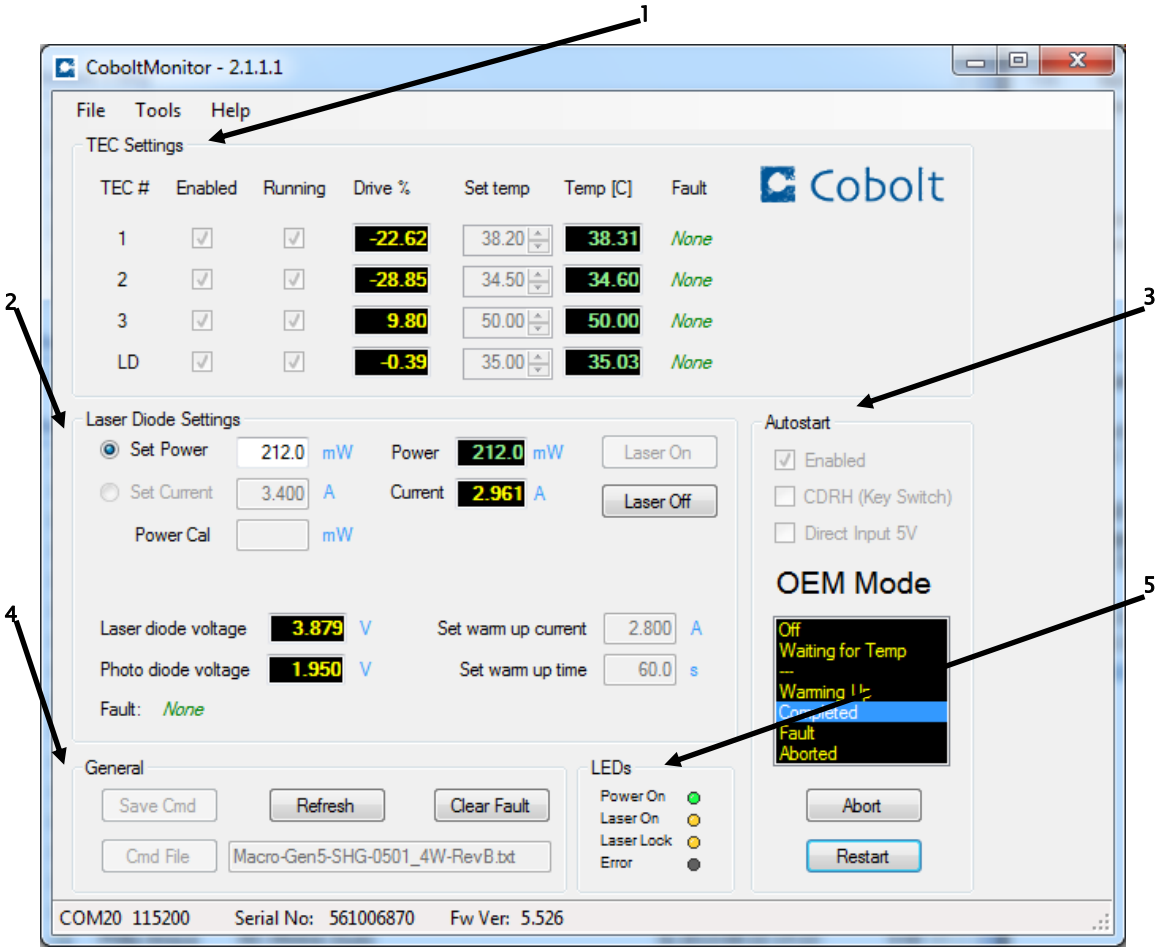
4. After a few security screens, setup will install .NET and Cobolt Monitor. A shortcut to software will be placed on the desktop and the program will run.

11.2. Software instructions

With the laser connected and powered, select "Options" from the "Tools" menu. The "Port name" drop-down box shows a list of available COM ports. Select the port which the laser is connected to and click OK. If the laser is connected via USB, it usually has the highest COM port number. See Section 9.1 for correct port settings.



To connect to the laser, choose "Connect" from the "File" menu. The window should now show the correct laser status along with various readings such as the laser power and current. The five different sections of the user interface are described below.



1. The **TEC Settings** section displays the internal temperature control of the Laser Head and the fault status for the laser's internal thermoelectric coolers (TEC). Depending on model the laser has two to four TEC active.

2. The **Laser Diode Settings** section displays the set laser power. The user can switch between constant power mode and constant current mode. Likewise, there are boxes to set the constant power level and constant current level. The output power (as monitored measured on an internal photodiode) and the current through the laser pump diode are both displayed.
3. The **Autostart** section displays whether the laser is in LAB or OEM mode and displays the current laser operational status. 5V direct input is set here, see Section 9.4. There are also buttons to abort the autostart sequence or restart the laser after a fault.
4. Under **General** there is a "Clear Fault" button. This can be used to restart the laser after the interlock has been removed and re-inserted.
5. The **LEDs** section displays the LEDs that are currently illuminated on the Control Box, see Section 4.2. These are displayed even if the laser is in OEM mode.

12. Troubleshooting

In the unlikely case of a problem occurring, use the table below to help identify the error. Some faults can be fixed remotely. Call Cobolt support or your representative to identify corrective action.

LEDs	Status		Explanation	Action
	off	flashing		
POW	x		Mains power off	Check connections
POW		x	Temperatures not stabilised	Check if heatsink is sufficient
LOCK		x	Laser can not lock in constant power, current limit has been reached	Check if heatsink is sufficient. Contact the factory.
ERROR		on	Error in laser parameters	If lights at start-up check cable connections, if lights >5s after start-up contact the factory

13. Warranty and maintenance

Cobolt provides a system warranty of 12 months after delivery, with unlimited number of operation hours.

The laser systems are designed for modular replacement or repair in the event that the Laser Head or Controller malfunctions. Warranty is invalid if the laser system is operated outside of the specific limits and conditions as outlined in this document.

The Cobolt lasers are contained in sealed enclosures and should not be opened for any reason. The warranty will be voided if any of the system units are opened. All laser parameters are set at the factory, and there are no adjustments required. Maintenance is limited to wiping dirt off the enclosures and cleaning the aperture. Clean the aperture with a standard photographers' lens airbrush.

14. Declaration of conformity (CDRH model only)

The Cobolt 05 lasers are designed and manufactured to comply with EC Low Voltage Directive and EC EMC Directive in their standard configuration of Laser Head, Controller, standard 1m cable and supplied with a Cobolt power supply unit. The equipment might not conform to the CE directive if any part of the supplied equipment is replaced with a part not supplied by Cobolt.

CE

The following harmonized standards are in use:

- Electrical safety: **IEC 61010-1:(2010), UL 61010-1, CAN/CSA-C22.2 No. 61010-1**
- Laser Class: **IEC-60825-1, CFR 1040.10-2002 and 1040.11-2002**
- EMC: **EN 61326-1:2006, incl EN 55011 Class A and FCC Part 15 subpart B class B**

In addition, Cobolt laser products pass ETC 900 019-2-2 Transport and Vibration Standards including IEC 60068-2-64, IEC 60068-2-29, IEC 60068-2-32, and Shock and Vibration IEC 60068-2-29.

Cobolt lasers are RoHS2 compliant as defined by the EC Directive 2011/65/EU.

Disabling the key-switch nullifies the CE marking as this violates the laser safety standard.

15. Disclaimers

Cobolt will assume no responsibility for damage incurred by faulty customer equipment, such as measurement equipment, cables etc, used in conjunction with Cobolt lasers.

Cobolt makes no warranty of any kind with regard to the information contained in this guide, included but not limited to, implied warranties of merchantability and suitability for a particular purpose. Cobolt shall not be liable for errors contained herein nor for incidental or consequential damages from the furnishing of this information.

16. Service

If the laser does not function, do not attempt to open any of the units, or the warranty will be voided. Call or e-mail your local Cobolt representative for consultancy and to request an RMA number (see back cover for contact information). If an RMA number us issued and the laser needs to be shipped back to Cobolt or your local representative, please pack the complete system for shipment using the original package or equivalent. Ensure the unit is free from thermal paste before packing. The warranty covers repair or replacing the unit at the option of Cobolt.

Cobolt

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